13281 U.S.PTO
010504

AN UP-CONVERSION MODULATION LOOP FOR MULTI-MODE MOBILE COMMUNICATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a signal modulation loop for the multi-mode mobile communication. The adaptive up-conversion modulation loop is used for performing the signal modulation so as to accomplish the signal modulation for the multi-mode mobile communication.

2. Description of the Prior Art

As the mobile phone gets more popular, the communication between the people gets more convenient. Not only the distance of the communication is shortened, but also the speed and efficiency for the proceeding of work are increased. Because of this, the capital and human resource are

continuously invested in the development and application of the mobile communication so as to obtain the better quality and service of the communication.

In order to make the transmission speed of the mobile communication faster and the service quality better, a great amount of capital and research effort is invested, and the communication transmission protocol is developed from the first generation, the American mobile phone system (AMPS), to the popularly used second generation, the global system for mobile communication (GSM). Even the mobile phone applying the third generation protocol, the code division multiple access (CDMA), is developed and appeared in the market. All of these protocols are provided for the user to make the communication

faster and have more various services. However, during the transition from one generation to another, the signal transmission and modulation between the different communication protocols become the crucial points of the development and research. Therefore, the multi-mode or multi-band signal transceiver is the main subject to be developed and researched for the wireless communication.

The conventional multi-mode adaptive up-conversion modulation loop is composed of a direct digital synthesizer, (DDS), a phase locked loop (PLL), a phase demodulator, a phase comparator and a control amplifier. Please refer to Fig.1. Fig.1 is a perspective diagram of a prior art modulation loop. The input modulation signal Mod is inputted into the phase comparator 10, and is compared with

the modulation signal outputted by the phase demodulator 11 so as to obtain a difference. This difference is used for controlling the direct feed-in path of an assistant control amplifier 12. After the modulation signal Mod is inputted in the direct digital synthesizer (DDS) 13, the direct digital synthesizer 13 will process it so as to obtain a stable and reliable modulation signal to be inputted into the mixer 14. Furthermore, the mixer 14 will receive the feedback signal transmitted by the frequency divider 1, and then process it so as to directly feed the input modulation signal in the loop filter 15 in the PLL. Thereafter, a adder 16 will receive the signals outputted by the loop filter 15 and the control amplifier 12 so as to obtain a transmission signal having a higher speed and

applying broad band. Then, the transmission signal is sent to a voltage controlled oscillator 17, and the voltage controlled oscillator 17 will output an emission signal to a power amplifier 3.

In the prior art, although the different modes of signals can be processed, the design has to be rearranged because of the usage of the direct digital synthesizer (DDS). The modulation loop further comprises the integrated circuits for the base band and radio frequency, and therefore, there are drawbacks for this application. Besides, because of the design method, there are drawbacks of vastly consuming electricity and occupying great area during usage. Thus, for the optimum transmission and design of the multi-mode communication system, the prior art cannot meet the needs of high-speed

transmission and various functions for the service.

SUMMARY OF THE INVENTION

The present invention relates to an up-conversion modulation loop for the multi-mode mobile communication. The base band and radio frequency integrated circuits applied in the global system for mobile communication (GSM) are combined with the signal feedback circuit for performing the modulation process so as to accomplish the multi-mode, multi-band signal modulation. Therefore, the requirements of the second and third generation communication transmission protocols will be met.

After the up-conversion modulation loop for the multi-mode mobile communication according to the present invention performs the signal modulation,

a structure having the optimum selectivity and compatibility for the frequency arrangement is obtained, and this structure can be applied in the global system for mobile communication (GSM). Therefore, the additional phase demodulator and phase comparator are not required for generating the signal difference. Thus, the objects of capable of being applied in multi-mode communication and having different signal bandwidths cab be achieved.

In order to be compatible with the base band and radio frequency integrated circuits applied in the global system for mobile communication (GSM) and reduce the occupied area and cost, the inventive loop is designed to generate the modulation signal difference after the processing of the phase modulator, and then pass the generated the

modulation signal difference through the assistant directly-feed-in path so as to accomplish the processing and outputting of the multi-mode, multi-band signals.

RIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form part of the specification in which like numerals designate like parts, illustrate preferred embodiments of the present invention and together with the description, serve to explain the principles of the invention. In the drawings:

Fig.1 is a perspective diagram of a prior art modulation loop;

Fig.2 is a perspective diagram of an

up-conversion modulation loop according to a first embodiment of the present invention;

Fig.3 is a perspective diagram of an up-conversion modulation loop according to a second embodiment of the present invention; and

Fig.4 is a flowchart of the steps performed by the loop according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates an up-conversion modulation loop for the multi-mode mobile communication. The base band integrated circuit and the radio frequency integrated circuit used in the global system for mobile communication (GSM) are applied with the signal modulation structure of the present invention so as perform the signal modulation and processing. Therefore, the

multi-mode and multi-frequency signal modulation can be accomplished by using a single power emitter, and the signal transmission for different communication protocols can be achieved.

Please refer to Fig.2. Fig.2 is a perspective diagram of an up-conversion modulation loop for multi-mode mobile communication according to a first embodiment of the present invention. The loop comprises a phase modulator 30 for receiving a feedback signal, and comparing it with the modulation phase signals Mod I, Mod Q so as to generate a difference. The phase modulator 30 comprises a phase converter 31. The phase converter 31 is used for receiving the feedback signal and performing the quadrature phase generation, and then outputting a in-phase feedback signal and a

quadrature phase feedback signal. The in-phase feedback signal is inputted into a first mixer 32. The first mixer 32 will receive the in-phase feedback signal and a first modulation phase signal Mod I outputted from outside of the phase modulator 30. After performing the mixing, the mixed signal is outputted to the first adder 34. The quadrature phase feedback signal is inputted into a second mixer 33. After the second mixer 33 receives the quadrature phase feedback signal and the second modulation phase signal Mod Q outputted from outside of the phase modulator 30, the mixing is performed in the second mixer 33, and then the mixed signal is outputted to the first adder 34. After the first adder 34 receives the mixed signals outputted by the first mixer 32 and the second mixer 33, the

signals are added and so as to obtain a phase signal difference. Then, the difference is outputted to the first filter 35 and the signal transmitter 47 outside the phase modulator 30. Therefore, the modulation and processing for the signal frequency and the signal phase can be achieved.

Sequentially, after the first filter 35 receives and processes the signal difference generated by the phase modulator 30, the signal is transmitted to the first frequency divider 36. The first frequency divider 36 will perform the signal down-conversion, and transmit the down-converted signal to the phase frequency comparator 37. The phase frequency comparator 37 not only receives the down-conversion signal transmitted by the first frequency divider 36, but also receives the second

down-conversion signal LO2 transmitted from the outside. The phase frequency comparator 37 will compare the phases of the two down-conversion signals, and then output the signal to the loop low-pass filter 38. After the loop low-pass filter 38 finishes the signal filtering, the signal is outputted to the second adder 39.

Furthermore, after the phase modulator 30 accomplishes the processing of the frequency phase, the signal will not only be inputted into the first filter 35, but also the signal transmitter 47. Then, the signal transmitter 47 will transmit the received difference signal to the signal amplifier 44. Besides, the phase detector 43 will receive the modulation phase signals, including a first modulation phase signal Mod I and a second modulation

phase signal Mod Q, and then detect the phases of the two modulation phase signals. Thereafter, the phase detector 43 will output the signal to the signal amplifier 44. After the signal amplifier 44 receives the difference signal transmitted by the signal transmitter 47, it will amplify the signal outputted by the phase detector 43 according to the difference signal, and then transmit the amplified signal to the second adder 39.

The second adder 39 will receive the signals transmitted by the loop low-pass filter 38 and the signal amplifier 44 for synthesizing the signals, and then transmit the synthesized signal to the voltage controlled oscillator 40. The voltage controlled oscillator 40 will perform the signal modulation so as to make the phases of the input

signal and the output signal consistent. Thereafter, the signal is outputted to the power amplifier 50 for amplifying the signal power so as to accomplish the signal modulation.

The above mentioned is the description for each of the units for the signal modulation according to the first embodiment of the present invention. The third mixer 41 will receive the signal outputted by the voltage controlled oscillator 40 and the first down-conversion signal LO1 inputted from the outside, and then mix the received signals. Thereafter, the third mixer 41 will transmit the mixed signal to the second filter 42. The second filter 42 will reject undesired signals, and then output the feedback signal to the phase converter 31 in the phase modulator 30.

Please refer to Fig.3. Fig.3 is a perspective diagram of an up-conversion modulation loop according to a second embodiment of the present invention. Similar to the first embodiment, the loop of the second embodiment also comprises the phase modulator 30, the first filter 35, the first frequency divider 36, the phase frequency comparator 37, the loop low-pass filter 38, the second adder 39 and the voltage controlled oscillator 40. The phase modulator 30 will receive the feedback signal, and compare it with the modulation phase signals Mod I, Mod Q so as to obtain a difference. The phase modulator 30 also comprises the phase converter 31, the first mixer 32, the second mixer 33 and the first adder 34. The phase converter 31 will receive the feedback signal for performing the quadrature

generation, and then output a in-phase feedback signal and a quadrature phase feedback signal. The in-phase feedback signal is inputted into the first mixer 32, and the first mixer 32 will receive the in-phase feedback signal and the first modulation phase signal Mod I for mixing the signals, and then output the mixed signal to the first adder 34. The quadrature phase feedback signal is inputted to the second mixer 33. The second mixer 33 will receive the quadrature phase feedback signal and the second modulation phase signal Mod Q for mixing the signals, and then output the mixed signal to the first adder 34. Thereafter, the first adder 34 will add the signals so as to obtain a signal difference, and then output the signal difference to the first filter 35 and the signal transmitter 47.

Continuously, after the phase modulator 30 outputs the difference to the first filter 35 and the signal transmitter 47, the signal transmitter 47 will transmit the received difference signal to the signal amplifier 44. Besides, the phase detector 43 will receive the first modulation phase signal Mod I and the second modulation phase signal Mod Q for detecting the phases of the two modulation phase signals, and then output the signal to the signal amplifier 44. The signal amplifier 44 will amplify the signal outputted by the phase detector 43 according to the difference signal, and then transmit the amplified signal to the second adder 39.

After the first filter 35 receives the difference signal outputted by the phase modulator 30, it will

reject undesired signal, and then output the processed signal to the first frequency divider 36. The first frequency divider 36 will down-convert the signal, and then transmit the down-converted signal to the phase frequency comparator 37. The phase frequency comparator 37 not only receive the down-conversion signal transmitted by the first frequency divider 36, but also receive the down-conversion signal transmitted from the outside. Compared with the first embodiment, the down-conversion signal is obtained after the first down-conversion signal LO 1 transmitted from the outside is down-converted by the second frequency divider 45. The phase frequency comparator 37 will compare the phases of the two down-conversion signals, and then output the signal to the loop

low-pass filter 38. After the loop low-pass filter 38 accomplishes the signal filtering, the signal is outputted to the second adder 39.

The second adder 39 will receive the signals transmitted from the loop low-pass filter 38 and the signal amplifier 44 for synthesizing the signals, and then transmit the synthesized signal to the voltage controlled oscillator 40. The voltage controlled oscillator 40 will perform the signal modulation so as to make the phases of the input signal and output signal consistent. Therefore, the signal is outputted to the power amplifier 50, and the power amplifier 50 will amplify the signal power so as to finish the signal emission.

As for the feedback signal, the third mixer 41 will receive the signal outputted by the voltage

controlled oscillator 40 and the first down-conversion signal LO1 inputted from the outside for mixing the signals, and then transmit the mixed signal to the second filter 42. Thereafter, the second filter 42 will reject undesired signal, and then the feedback signal is outputted to the phase converter 31 in the phase modulator 30.

Besides, another difference between the first and second embodiments is the second embodiment further comprises a signal amplitude detector 46. This signal amplitude detector 46 will receive the modulation phase signals, including the first modulation phase signal Mod I and the second modulation signal Mod Q. Then, the signal amplitude detector 46 will detect the signal amplitude, and then control the output amplitude of power amplifier

50.

The above is the detailed description of the embodiments of the multi-mode mobile communication up-conversion modulation loops according to the present invention. By means of the signal modulation, detection and transmission, the global system for mobile communication (GSM) and the wideband code division multiple access (WCDMA) are integrated for the signal emission. Please refer to Fig.4. Fig.4 is a flowchart of the steps performed by the loop according to the invention. In the step 400, the first modulation phase signal and the second modulation phase signal is transmitted to the phase modulator and the phase detector. The phase modulator is used for comparing the signals, and the phase detector is used for detecting the phases

of the two modulation phase signals. Thereafter, the phase modulator will generate the difference in the step 401. In the step 402, the phase modulator will transmit the difference to the signal transmitter and the first filter, and then the first filter will transmit the difference to the phase frequency comparator and the loop low-pass filter so as to compare and filter the signals (step 403). Then, a signal amplifier will amplify the signals outputted by the phase detector and the signal transmitter, and then a first adder will synthesize the signals in the step 404. The synthesized frequency signal is transmitted to a voltage controlled oscillator, and the voltage controlled oscillator will modulate the phase frequencies of the input and output signals in the step 405 so as

make the modulation phases of the output and input signals consistent. Finally, a modulation signal with consistent phase is outputted to a power amplifier so as to output and emit the multi-mode mobile communication up-conversion modulation signal in the step 406.

In summary, the present invention effectively process the signals used in the second generation, the global system for mobile communication (GSM), and the third generation, the wideband code division multiple access (WCDMA), communication protocols, and a single circuit is used for performing the signal up-conversion and modulation. Therefore, the communication efficiency can be promoted and the drawbacks of the prior art can be avoided.

Those skilled in the art will readily

observe that numerous modifications and alterations of the device may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.